

P53 Turret – A Unique Design of Its Own Class

Babu George, Zhibin Zhong and Frederic Basset
SBM Atlantis, Inc
Houston, TX, USA

ABSTRACT

A Floating Production Unit (FPU) is utilized as a hub to collect, process and export the produced oil and gas from the Marlim Leste Field, located in the Campos basin, offshore Brazil. This particular FPU, named P53, is a turret moored converted VLCC tanker. Once operational, the turret mooring system will be the largest in the world serving a total of 75 risers, including umbilicals. The paper describes the process and special considerations given to the development of the world's largest turret mooring system. A succinct description of the turret and the key challenges are presented. The design serves as a model for the development of future large number of remote satellite wells and fields using ship shaped floaters.

KEY WORDS: FPU; FPSO; turret; mooring; bearing; swivel

INTRODUCTION

The P53 FPU functions as a mini hub wherein production from various satellite wells are received, processed and exported to the nearby P-26 platform for further export. The FPU is stationed at the Marlim Leste Field located at the deep central area of the Campos Basin, offshore Brazil; Fig 1. The FPU design life is 25 years without dry-docking. The vessel has no storage capability. The FPU and its mooring system are classed according to the rules and regulations of Bureau Veritas.

The FPU has an internally mounted turret with a 3x3 mooring system. The taut mooring lines are composed of chain/polyester rope/chain segments and are secured to the seabed by anchors. The turret system utilizes the SBM Inc. proprietary bogie wheel concept and has an overall turret cylinder diameter of 24.8 m.

The field sub-sea architecture comprises of 18 individual oil production and 9 water injection wells. All the wells are connected to the FPU through flexible risers. 18 Gas lift risers and 28 umbilical are utilized for well/production management. The produced gas from the FPU is exported to the nearby P-26 platform through a 10" flexible riser.

A single 12" riser is utilized for processed crude oil export from the FPU to the PRA-1 platform. In total the FPU will have 75 flexible risers, which makes the system unique by a large margin.

The FPU process plant is capable of handling oil production and treatment of 180,000 bpd and will have liquid capacity of 190,000 bpd, gas compression capability of 6,000,000 m³/d (212 million cubic feet per day) and water injection capacity of 39,000 m³/d (245,000 bwpd).

FIELD & FPU DATA

Field water depth is 1084 m, referenced to as Mean Sea Level (MSL). Water level changes at the site due to tidal effects are:

Highest Astronomical Tide +1.0 m
Lowest Astronomical Tide -0.9 m

The main particulars of the FPU are as follows:

- Length overall – 348.2 m
- Length between perpendiculars – 333.9 m
- Breadth – 57.3 m
- Depth – 28.5 m
- Loaded draft – 22.2 m
- Operational draft – 16 m
- Displacement – 349,150 t

The turret mooring system is designed with 100 year return conditions being the extreme design event and 1 year return conditions being the limiting design operational condition. In general, the site can be characterized as having moderate environmental conditions, vis-à-vis winds, waves, tides, and currents. The metocean data applied in the turret mooring system design is listed in Tables 1, 2 & 3.

The FPU motion characteristics are shown in Figure 3 with its natural periods given in Table 4.